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Short communication

Field evaluation of a new light trap for phlebotomine sand flies

Gabriella Gaglio*, Ettore Napoli, Luigi Falsone, Salvatore Giannetto, Emanuele Brianti

Dipartimento di Scienze Veterinarie di Messina, University of Messina, Messina, Italy

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ABSTRACT

Light traps are one of the most common attractive method for the collection of nocturnal insects. Although light traps are generally referred to as "CDC light traps", different models, equipped with incandescent or UV lamps, have been developed. A new light trap, named Laika trap 3.0, equipped with LED lamps and featured with a light and handy design, has been recently proposed into the market. In this study we tested and compared the capture performances of this new trap with those of a classical light trap model under field conditions. From May to November 2013, a Laika trap and a classical light trap were placed biweekly in an area endemic for sand flies. A total of 256 sand fly specimens, belonging to 3 species (*Sergentomyia minuta*, *Phlebotomus perniciosus, Phlebotomus neglectus*) were collected during the study period. The Laika trap captured 126 phlebotomine sand flies: *P. perniciosus* (n = 38); *S. minuta* (n = 88), a similar number of specimens (130) and the same species were captured by classical light trap which collected also 3 specimens of *P. neglectus*. No significant differences in the capture efficiency at each day of trapping, neither in the number of species or in the sex of sand flies were observed. According to results of this study, the Laika trap may be a valid alternative to classical light trap models especially when handy design and low power consumption are key factors in field studies.

1. Introduction

Sand flies are small dipteran insects, featured by crepuscular or nocturnal activity and weak direct flight capability. Both male and female requires sugars for energy, but only female needs blood meal for eggs maturation (Alexander, 2000). Sand flies are vectors of various bacterial, viral and protozoal diseases, as for instance leishmaniosis (Maroli et al., 2013). The knowledge of the behavior and habits of the different species of sand flies is essential to their control and, for those having a vectorial role, to decrease the risk of transmission by implementing efficacious and timely preventive actions (De Oliveira Miranda et al., 2015). For sand fly surveillance three methods are commonly used, including human landing collection, sticky traps and light traps, (Killick-Kendrick, 1987; Alexander, 2000). In addition, other techniques such as aspirator collections and flight traps can be regarded (Alten et al., 2015). It has been demonstrated that the human landing collection attracts the largest number of sand flies (Hanafi et al., 2007); however, this method presents several constrains such as the attractiveness of the collector, the impossibility of use this method on a large scale and for prolonged periods and, last but not least, the exposure of the collector to diseases transmitted through sand fly or other hematophagous insect bites (Müller et al., 2011). Among trapping devices, sticky traps, mainly used to determine the relative density of phlebotomine populations, can catch only flies from their immediate area (Burkett et al., 2007) and, even though this method is very cheap and easy to set, the captured specimens are dead and sometimes too damaged to allow their identification to species level. In addition, sticky traps, are not commonly employed for virus isolation studies because the impregnation oil could interfere with cell culture (Moore and Gage, 1996) and virus isolation is lower compared with that obtained using specimens captured with light traps (Remoli et al., 2015).

The primary light trap was developed by Sudia and Chamberlain in 1962 and referred to as CDC (Center for Diseases Control and Prevention) light trap, and subsequently modified to improve the effectiveness (Stewart, 1970; Johnston et al., 1973; Elston and Apperson, 1977; Addison et al., 1979). In the following years, different models of light traps, still inspired to the CDC prototype, have been realized. Currently, light traps are regarded as a reliable system for collection of large amount of live or well preserved insects allowing an easier identification of captured specimens and their use for further investigations, e.g. PCR or pathogens isolation and culture (Remoli et al., 2015). Even if light traps could be extensively used in field studies, their size, weight and power consumption, are still disadvantages, especially when collections are carried out in remote areas (Cohnstaedt et al., 2008). Recently, light traps have improved by substitution of incandescent light bulb with light-emitting diode (LED) (Cohnstaedt et al., 2008; Mann et al., 2009; Müller et al., 2015). LED traps display some advantages as, for example, the reduction of electric consumption that results in a

* Corresponding author at: Polo Universitario Annunziata, Messina 98168, Italy.
E-mail address: ggaglio@unime.it (G. Gaglio).

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longer battery life. Furthermore, the light intensity, wavelength and color of the LED can be easily tuned thus providing a wide variety of customizations. The effectiveness of LEDs technology to collect insect has been investigated for some species of mosquitoes (Liu et al., 2017), and *Culicoides* flies (Cohnstaedt et al., 2008), however only few studies investigated the efficacy of LEDs in sand fly collection so far. In particular, a study investigated the attractiveness of LED traps for *Nyssomyia whitmani* and *Lutzomyia longipalpis* (Silva et al., 2015), demonstrating that green and blue LEDs have the same attractiveness of incandescent light bulb; while only a study investigated the effect of different LED colors on *Phlebotomus papatasi* (Hoel et al., 2007). This latter study reported that the species was more attracted by red LED compared to blue, green LEDs or incandescent light.

To the best of our knowledge, no studies have investigated the attractiveness of LED traps to phlebotomine sand fly species in southern Europe. Therefore, the aim of the present study was to test a new LED light trap, named Laika trap 3.0, and to compare its capture performances with those of a classical light trap model in an area where sand fly species are present and act as vectors of *Leishmania infantum*.

2. Materials and methods

The study was conducted, from May to November 2013 in a rescue shelter where about 400 dogs were housed. The shelter is located in the province of Syracuse (southern east Sicily, Italy, Lat 37.084363° Lon 15.206653°), an area regarded as endemic for canine leishmaniasis (Brianti et al., 2016). The area is characterized by mild wet winters and warm to hot dry summers. The average of temperatures ranges from 14.8 °in January to 31.3 °in August (Archivio climatico Enea-Casaccia, 2014).

The LED trap used in this study is featured by a platform-based design (Fig. 1a) and equipped with two LED lamps able to emit UV the first (250 mcd and 395 nm of wavelength) and white light the second (11,000 mcd and 455 nm of wavelength) for a total power comsuption of 0.3W. The trap weights 230 g. This trap has been designed and produced by Laika® Lab (Pozzuolo, Italy) under the name of Laika trap 3.0 (LT) (Fig. 1b). The classical light trap (CLT) used for comparison in this study is the model IMT (Fig. 1c) produced by Byblos (Cantù, Italy), with a weight of 700 g, equipped with an incandescent light bulb of 12 V and a power consumption of 3W. During the study period the LT and the CLT were placed biweekly in a side of the shelter at 50 cm from the ground, as suggested by Gaglio et al. (2014), and at three meters of distance between each other. The CLT was used without CO_2, each trap was plugged to a battery of 12 V and 7 Ah and left working from 6 p.m. to 6 a.m. Capturing was suspended after three consecutive negative trapping sessions.

Sand flies collected were separated from other insects and stored in vials filled with 70% ethanol according to date of sampling and model of trap. The sand flies were processed as described elsewhere (Gaglio et al., 2014) and identified to species level using morphological keys (Dantas-Torres et al., 2014a).

The differences in number, species and sex sand flies collected by the use of the two different traps were statistically analysed using Mann-Withney *U* test. Differences were considered significant if $p < 0.05$. Statistical analyses were performed using GraphPad Prism version 5.00 for Windows® (GraphPad Software, San Diego California US, www.graphpad.com).

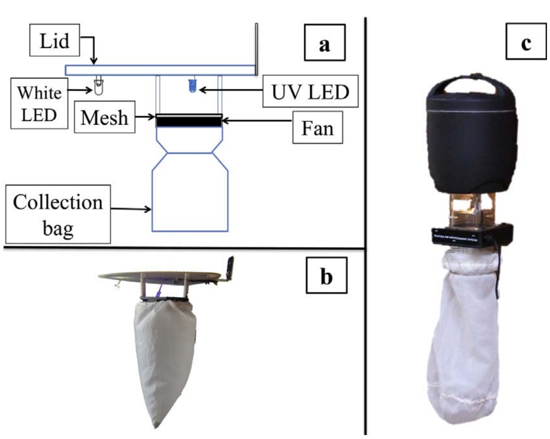

Fig. 1. a) Schematic representation of Laika trap 3.0; b) Laika trap model and c) Classical light trap (IMT model) used in the study.

3. Results

A total of fourteen sampling sessions were carried out; however, any sand fly was collected in the first and in the last three sessions (Fig. 2a). Overall, 256 (93 males and 163 females) sand flies, belonging to three different species namely, *Sergentomyia minuta* (n = 150), *Phlebotomus perniciosus* (n = 103) and *Phlebotomus neglectus* (n = 3) were collected. Sand flies were mainly collected in the months of June and August, while the only three specimens of *P. neglectus* were collected in July. Both the traps captured sand flies in the same sessions with no significant differences. The CLT collected a total of 130 sand flies (*P. perniciosus* = 65, *S. minuta* = 62, *P. neglectus* = 3, and the LT 126 specimens, identified as *P. perniciosus* = 38 and *S. minuta* = 88 (Fig. 2b). No significant statistical differences were observed in the total number of sand flies captured by the two trap models neither in the species or in the sex (Figs. 3 and 4).

4. Discussions

The present study reports for the first time the effectiveness of LED trap in the capture of sand fly species endemic in the Mediterranean area where some of the captured species (i.e. *P. perniciosus* and *P. neglectus*) act as vectors of leishmaniosis by *L. infantum.* Moreover, by the comparison of capture's competences between this new device and classical CDC-like traps, results here reported show that LT can be regarded as a valid and reliable tool for sand fly collection since no differences were observed in sand flies collection. In fact, both traps collected almost the same number and species of sand flies along the sampling sessions, showing to be equally attractive under the same environmental and meteorological conditions. The species composition observed in the present survey is consistent with data reported in previous studies, in which the best-represented species was *S. minuta*, followed by *P. perniciosus* (Brianti et al., 2016; Gaglio et al., 2014; Lisi et al., 2014). The limited presence of *P. neglectus* here observed is also coherent with previous observations in southern Italy (Gaglio et al., 2014; Dantas-Torres et al., 2014b) and it is justified by the northern gradient of this species in Italian regions (Signorini et al., 2013; Maroli et al., 2008).

The estimation of sand fly abundance and richness is not an easy task, in fact, the trapping method as well as other variables (i.e. animals' presence, landscape features and climate), may influence considerably the capture either in terms of abundance and diversity (Ghrab et al., 2006). Among the variables that could affect such a trapping method, a crucial role is played by the attractiveness of the trap equipped with different lamp models (LED, incandescent, coloured or white); indeed, theoretically, nocturnal insects, are provided by a trichromatic vision with photoreceptor sensitivities detecting the ultraviolet, green and blue wavebands (Briscoe and Chittka, 2001). However, some experiences that used light trapping method, have unexpectedly obtained contradictory results in this field. In fact, it has been demonstrated that *Phlebotomus papatasi* is attracted four times more by red LED than blue or green LEDs and twice than incandescent light bulb (Hoel et al., 2007). Another study, conducted in Brazil, showed that classical Hoover Pugedo light traps equipped with green or blue LEDs or incandescent light have the same attractiveness power for